PRAWN AND FISH CULTURE FOR INCREASED YIELDS

R.V. NAIR, K.H. MOHAMED and P. BENSAM
Central Marine Fisheries Research Institute, Cochin

ALTHOUGH culture of marine fish and shell fish in one form or the other has been in existence in different parts of the world from ancient times, yet its progress has been rather slow till a couple of decades ago. Over the years, accent has been on exploitation of the readily available natural stocks from seas rather than on culture operations. Consequent on the introduction of better and effective fishing techniques, limitations of the capture fishery have been increasingly felt in different parts of the world and as an alternative source for augmenting production, culture fishery for marine species has assumed greater importance in recent years. Besides, production from culture sources has certain additional advantages particularly in the matter of providing fresh and wholesome sea food for the consumers, stabilizing the supplies, exercising controls, undertaking management procedures and for providing employment opportunities.

Among the various ecological niches in the sea and its adjoining areas, the coastal zone including the shore, shallow inter-tidal region, estuaries and their banks, salt marshes, mud flats, swamps, lagoons, lochs, creeks, backwaters, etc. have been used for culture operations for a long time. The utilisation of the sea proper for culture, particularly the open areas, is of recent origin and has been accomplished by the development of materials and techniques for erecting enclosures, floating rafts, net cages, etc. These ventures are rather expensive and are practised mostly in some affluent countries for raising luxury items for specialised markets, but in a developing country like India the immediate task is the production of cheap animal protein. It is in this context that marine farming for fish and shell fish acquires greater importance for development in the coastal areas.

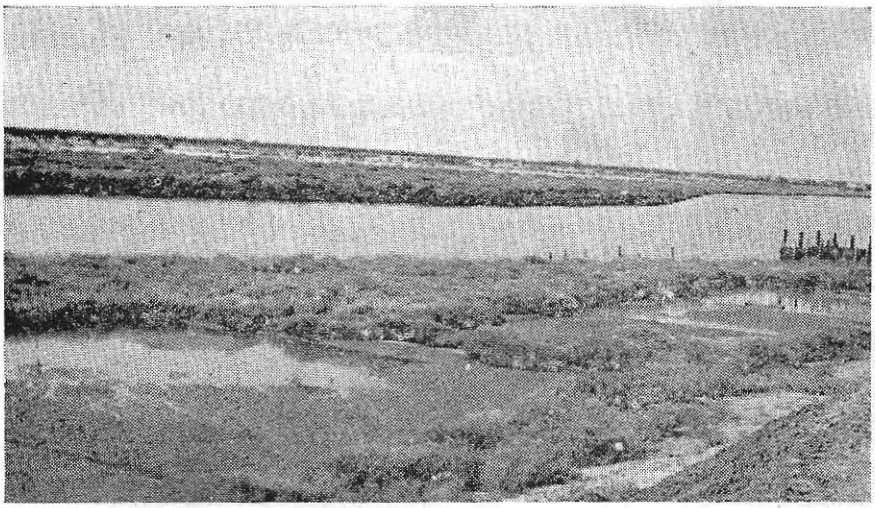
Marine Prawn Culture

Culture of prawns is one of the most important of the mariculture operations practised in different parts of the world. The prawn culture practices traditionally prevailing in the coastal areas of the south-east Asian countries gradually changed their pattern as more and more information became available to the culturists and the administrators. The successful rearing of the Japanese prawn *Penaeus japonicus* by Hudinaga in 1960 and subsequent development of commercial prawn culture in that country provided impetus for taking up such operations in other parts of the world. For a long time prawn culture operations in India were restricted to Kerala and West Bengal, but as it became known that the vast stretches of seemingly unproductive swamps and lagoons could be brought under effective prawn cultivation, all the maritime states started taking interest in this field of development.

Most of the littoral species of our marine prawns are suitable for cultivation in the coastal brackish water areas lying within the range of tidal flow and their life-histories are adapted for such operations. Although these prawns spawn in the sea and complete their larval history in the pelagic realm of the coastal waters, they enter the brackish water regions of the estuaries and swamps when they are in the post-larval stages. In the estuarine environment, which forms the nursery ground of the juvenile prawns, the post-larvae settle down as they acquire bottom-living habits and grow till they attain a specific size. When they are about to attain maturity they abandon this habitat and migrate to the sea where only they attain sexual maturity and spawn. The traditional culture practices, therefore, take advantage of this migratory behaviour of prawns as the post-larvae and juvenile prawns brought into the estuaries by tidal flow are trapped and impounded in suitable ponds constructed along the banks of tidal estuaries. In Kerala alone over 5,000 ha of land lying adjacent to backwaters is presently being utilised for these culture operations which yield an estimated catch of 6,000 tonnes of prawns in a year.

Traditional Culture for Prawns

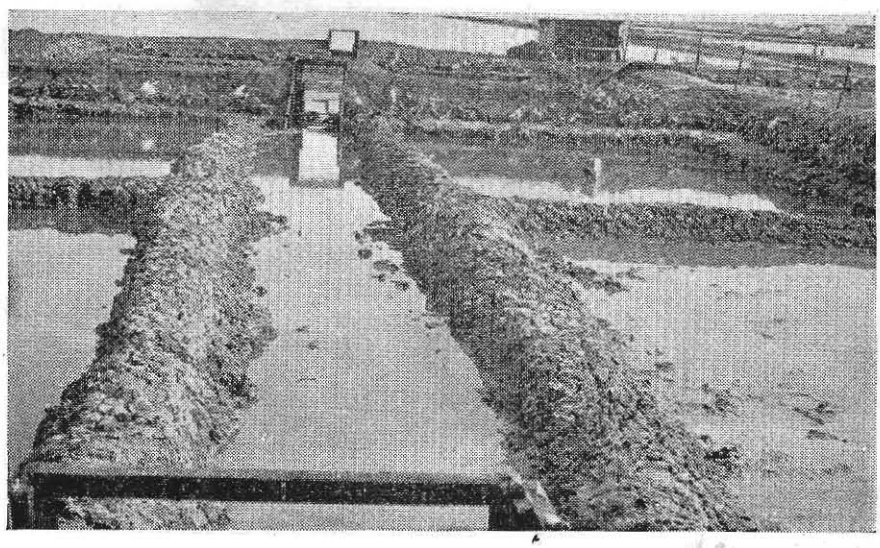
The impoundments constructe along the banks of the estuaries are under paddy cultivation during monsoon period (June to September) when the salinity of water is very low. Prawn culture operations are carried out in the same fields during other months of the year (October to May). Soon after the paddy crop is harvested in September, the bunds of the fields are strengthened and wooden sluices are fixed to control the flow of water to and from the impoundments. The estuarine water which contains post-larvae and juveniles of prawns are freely let into these impoundments through the sluices during high tide. When the tide recedes the sluice gates are partially opened and water is allowed to flow out through a bamboo screen fixed in the sluice gate to prevent the escape of the juvenile prawns which have entered during high tide. This practice is repeated at every high tide and low tide. The environment provided in these impoundments is suitable for natural growth of prawns and those caught in the impoundments feed and grow on the naturally available plant and animal life. Periodic harvesting is conducted during spring tide



A view of the salt pan fish culture farm at Veppalodai, near Tuticorin

periods when maximum amplitude of tide is available. For this a special conical net is fixed to the mouth of the sluice and water from the impoundment is let of through it at great force during low tide. The prawns get collected in the cod end of the net and are removed periodically. When total harvesting is to be done at the end of the culture season various capture methods including hand picking are resorted to. Each of these paddy-cum-prawn culture units occupies areas varying from 0.5 ha to over 60 ha but a unit of 10 to 15 ha is considered to be better suited for efficient management. Production figures also vary considerably—500 kg per ha to 1,200 kg per ha per season.

Based on the investigations carried out by the Central Marine Fisheries Research Institute this system of prawn culture has been evaluated from the stand point of efficiency of management and productivity. Although the system, as such, is high yielding and productive, three chief defects have been noticed and they are as follows.



A view of the banks of an estuary suitable for conversion into marine fish culture ponds

1. The stocking in the impoundments is carried out indiscriminately and every organism that comes along with the high tide gets into the impoundment. All productive and unproductive species are stocked by this process.
2. The stocked prawns are left in the impoundments only for a short time as the harvesting is carried out in every spring tide period. In other words, the stocked prawns are allowed to grow for a maximum period of a fortnight only.
3. Predatory and competitor species also enter the impoundments along with prawns as the stocking procedure is not properly organised.

All these defects can be remedied with a little extra effort on the part of the culturist. Stocking of the desired species and adoption of systematic culture practices can certainly increase the yield and its value considerably. The additional expenditure involved in adopting these techniques will be insignificant as it calls for only one extra worker for a 10 ha plot.

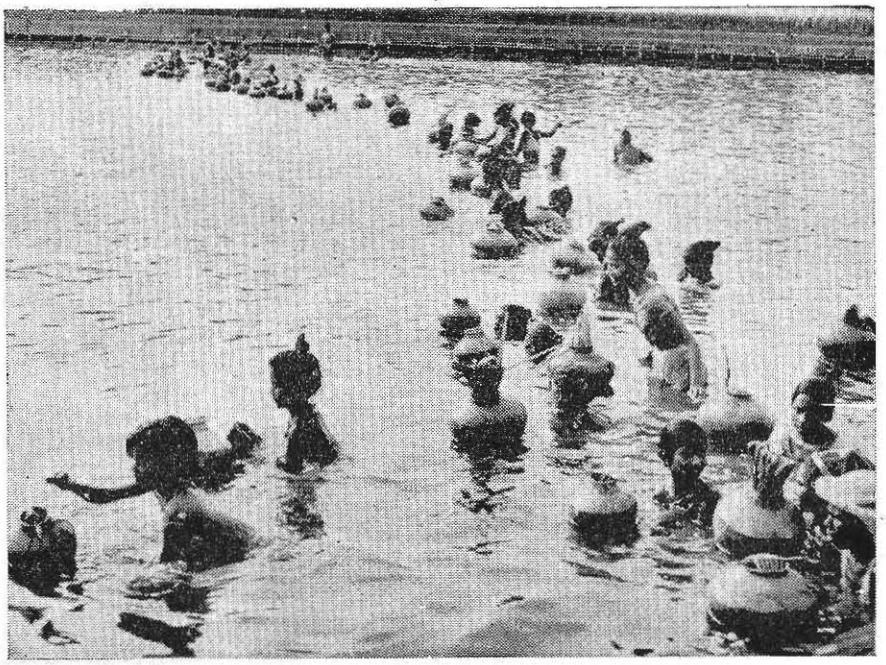
Suitable Species

Among the Indian species of marine prawns the following are suitable for culture purposes in the brackish water regions.

1. *Penaeus indicus* (Indian prawn)
2. *Penaeus monodon* (Tiger prawn)
3. *Metapenaeus affinis* (Grey prawn)
4. *Metapenaeus monoceros* (Indian pink prawn)
5. *Metapenaeus dobsoni* (Flower tail prawn)
6. *Metapenaeus brevicornis* (Yellow prawn)

Of these *P. indicus* and *P. monodon* are more valuable species as they grow to a large size in the impoundments. The seeds of these prawns are readily available in the estuarine brackish water areas and from the

surf regions of the sea. Experiments conducted by the CMFRI have shown that the seeds (post-larvae) of *P. indicus* are readily available from the surf regions of the sea and that they can be directly stocked in the brackish water rearing ponds without significant mortality. These prawn seeds can be collected throughout the year although better collections are obtained in August-September. This is a very good period for stocking them in impoundments on the west coast of India as the salinity of water in these impoundments begins to increase from that period. It is also seen that these post-larvae attain marketable size of 135 mm (20 g) in about 5 months time in the natural ponds without artificial feeds. Growth rate noticed in *P. monodon* is still higher although its availability is considerably low.



Hand-picking of prawns at Narakkal, near Cochin

Prawn culture ponds at Narakkal, near Cochin

Artificial Spawning of Prawns

One of the important factors that control the success of culture operations is the free availability of seeds. Collection of seeds from the natural sources has its limitations and it would be necessary to find methods to produce seeds artificially in desired quantities. This can be achieved only by getting the adult prawns to spawn under controlled conditions. Initial efforts made in this direction at the CMFRI have met with success and recently most of the commercially exploited species of prawns have spawned in the laboratory. Rearing experiments are in progress and it is hoped that within a short time it would be possible to produce prawn seeds of the different species required by culturists for stocking purposes.

Prospects

At present the average production rate by the traditional methods of culture is only about 700 kg per ha in a year. This includes about 70 per cent of *M. dobsoni* and 30 per cent of *P. indicus* and *P. monodon*. While the price for *M. dobsoni* varies from Re 1.00 to Rs 1.50 per kg that of *P. indicus* and *P. monodon* varies from Rs 10.00 to Rs 20.00 per kg. At an average rate the revenue from this production amounts to Rs 3,500 per ha per year. By adopting scientific culture practices it would be possible to obtain a production rate of 1,000 kg per ha of *P. indicus* and *P. monodon* alone twice a year. This will bring in a revenue of over Rs 30,000 per ha per year. The organisation of demonstration farms in all the martime states will enable culturists and new entrepreneurs to learn the techniques and adopt scientific methods of prawn culture with definite advantage.

The numerous lagoons, estuaries and inlets found all along the coastline of India are suitable for fish culture. There are a number of cultivable species of fish occurring along the coasts of India and among them the milkfish *Chanos chanos*, the mullets *Mugil cephalus, Liza tade, Rhinomugil corsula,* the giant perch *Lates calcarifer,* the pearl spot *Etroplus suratensis,* etc. are the most important. The fry of most of these appear in large numbers in the inshore waters, estuaries and back-waters, and it is possible to collect millions of them in appropriate seasons.

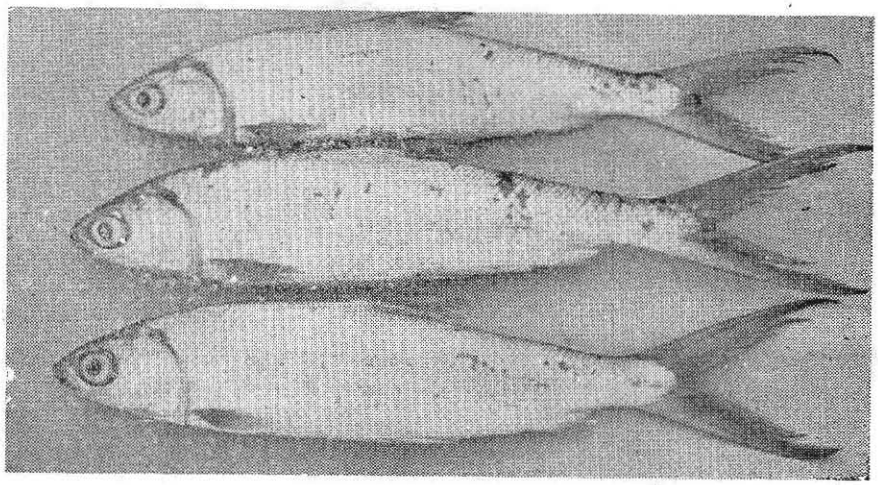
An unorganised system of stocking and harvesting of fishes in the coastal estuarine areas has been prevalent in different places, particularly in Bengal, Kerala and Goa. Commercial culture of mullets in the low-lying lands near estuaries and deltaic areas as well as in paddy fields of Bengal has been carried out, without resorting to management of the ponds. The production was low because of unsatisfactory water supply, inadequate and haphazard stocking, failure to eradicate predators, lack of proper food and the limited period of culture. Mullet culture in a specialy prepared farm was undertaken at Cochin with encouraging results; but follow-up work does not appear to have been pursued. Although mixed culture of milk fish, mullet and pearl spot is practised commercially in several other farms of the Kerala State it has not reached the position of a stable culture industry. *Lates calcarifer* is cultured in some ponds and canals in Bengal, but intensive cultivation on modern lines is yet to be taken up.

Marine fish farming has advanced significantly in the recent past in many countries. Apart from the traditionally well known euryhaline species for culture in coastal areas, many pelagic species such as the yellow-tail and tuna have now been found to be of culture value in open seas. Also, considerable progress has been made in the procurement, production and conservation of fry. In the field of management procedures notable developments have been made in pond preparation, maintenance, increasing the abundance of natural food, protection of stock from predators, etc. Fishes subsisting at the bottom of the food chain are preferred for culture, because of the lower investments required and the continuing demand for cheap animal protein.

For promoting survival, growth and production of fishes like mullets and *Chanos,* different methods have been evolved recently in different parts of the world. In Italy mullet farms are so designed and constructed that either salt water or fresh-water can be allowed into the farm at will, because mullets grow more rapidly in an admixture of salt and fresh water. In the United Arab Republic the use of phosphate fertilizers in mullet ponds has increased the production; and in Hawaii diatoms and algae are grown on plastic sheets for feeding mullets. In Taiwan and Hongkong intensive management procedures in mullet farms have resulted in as high a production as 3,500 kg per ha during a growing season. Similarly, in the case of *Chanos* culture in Indonesia, Philippines and Taiwan the ponds are subjected to such preparations as tilling, raking, manuring, etc. This encourages the growth of algal pastures on which *Chanos* feed and grow rapidly. In Taiwan and Philippines a system of stocking and cropping by rotation has become possible to harvest large-sized *Chanos* at 2 to 4 weeks interval throughout the cropping season. Stock manipulation using different kinds of natural food has also been developed recently. By adopting such techniques, the production has been raised to 1,900 kg per ha from the traditional harvest of only about 500 kg per ha.

Keeping such developments in view, the CMFRI has been carrying on experimental work on the culture of marine fish with special reference to *Chanos.* In the fifties a farm was constructed in a mud flat area at Mandapam for demonstrating *Chanos* culture. The results obtained were quite encouraging and it was shown that a production of up to 455 kg per ha could be obtained from a biologically poor environment by following some management procedures.

As part of the Institute's work for culturing marine fish in different ecological niches experimental culture of *Chanos* in the salt pan areas at Veppalodai near Tuticorin was taken up during 1972-73. A farm was constructed in one of the primary reservoirs used for storing sea water for producing common salt.



The milk fish Chanos chanos extensively used for fish culture

The fingerlings stocked in the farm depended entirely on the planktonic organisms brought by the sea water pumped into the reservoir and also on the thin growth of algae at the substratum. The results of the experiment undertaken during 1973-74 have shown a production rate of 857.47 kg per ha per annum. This has demonstrated that the production of *Chanos* in the salt pan areas without any management procedures was quite encouraging. By adopting appropriate management procedures it is possible to increase the production considerably.

The encouraging results obtained in the culture of marine prawns and *Chanos* in India and recent advances made in culture fishery in other parts of the world call for the implementation of intensive culture programmes all along the coastal areas. Along the 5,500 km coastline of India we have about 7,00,000 ha of estuarine waters which can be utilised for culture purposes. As a preliminary step it would be necessary to make an objective assessment of the available areas with special reference to their suitability for culture. Detailed information on the topography, climatic conditions, physico-chemical and biological characteristics, productivity, seed and fry resources, etc. in respect of each of the prospective site has to be obtained before the design of a farm is to be finalised.

Culturing fish and shell fish in cages in the open seas is a field in which new developments are taking place in other parts of the world. The possibility of introducing such methods in the culture of Indian species such as pomfrets, seer-fish, tuna, carangids, etc. should be given more serious thought in the coming years.

CONTINUED FROM PAGE 24

FISH FARMING IN MAN-MADE LAKES

macro-vegetation and molluscs. The omnivorous *C. carpio* is another useful addition as stocking material for our reservoirs. In addition to carps, cafishes like *Pangasius pangasius* which take to snails and bivalves and *Mystus cavasius* and *Ompok bimaculatus* which feed on insects and molluscs are also desirable additions. For reservoirs in higher altitudes and with colder water regime, the fishes like *L. dero, Tor* spp., *Schizothorax* spp., and *Oreinus* spp. are suitable. In addition, exotic carps like mirror carp (*C. carpio specularis*), *H. molitrix, Tinca tinca* and *C. carassius* will also do well in these waters. Trout has been stocked in some of the impoundments in Nilgiris. *Tilapia mossambica* has shown great promise in a few reservoirs in Tamil Nadu. But they proved harmful to carp fishery. Great caution is indicated before this fish is considered for stocking in any reservoir in India.

Going by the studies carried out in D.V.C. reservoirs it has been calculated that stocking at 250 fingerlings per ha for reservoirs where there are no predatory fishes and 550 fingerlings per ha for reservoirs with predatory fishes is considered desirable. The above stocking rate will have to be changed for each reservoir taking into consideration the productivity of the water, the abundance of predatory populations, the survival rate of the fry and fingerlings and the growth rate of the fishes. In new impoundments the stocking rate will have to be of higher order for reasons already discussed. The size of fingerlings should not be less than 3 inches.

Recent studies have shown that the intermediate zone and its bays are very rich in plankton. Taking advantage of this, the stocking of fry and fingerlings of major carps should be done in this zone after making sure through trial netting that the predatory fishes are not present. The present practice of stocking fry and fingerlings in the lentic zone is unproductive and should be discontinued.

Fertilization in man-made lakes, unlike ponds and small bodies of water, is very expensive and the results are of transitory value on account of inflow and outflow and the vast areas involved. Alternate methods of enrichment will therefore have to be examined. One of the consequences of draw-down is the seasonal exposure of the littoral areas. These peripheral areas should be used for foreshore cultivation. A number of deep water paddy varieties are known to grow in rising water levels. Some steps in this direction have already been taken in the Tilaiya reservoir. Such foreshore farming not only gives the much-needed cereals but the remnants of the plants, on decay, release fertilizing substances such as potassium and phosphate and thus enrich the water.

For successful fish harvest it is necessary to know the dispersal of stocks both in time and space. Some studies carried out in Konar and Tilaiya reservoirs have brought out the interesting fact that fish are in greater abundance in mid-zone in May and June, in upper zone in August, in mid-zone in October and in lower zone in November and December. Taking advantage of fish distribution, it is possible to exploit the fish stocks successfully and realise better catch per unit of effort.

Fish farming techniques in man-made lakes will have to include some capture fishery principles which include imposition of size limit, mesh regulation and 'closed season'.

The yields in some of our man-made lakes already compare favourably with those of Africa (40 to 50 kg per ha per year), the U.S.S.R. (18 to 36 kg per ha per year) and the U.S.A. (33 kg per ha per year). By adopting scientific fish farming techniques it should be possible to get an average harvest of 75 kg per ha per year from our man-made lakes. For an estimated 2 million hectare of water area available under impoundments it should be possible to realise an yield of 1.5 lakh tonnes of fish.